

We claim:

1. A poppet-type check valve for controlling fluid flow, comprising:
  - (a) a valve housing having an interior for permitting fluid flow from an upstream side to a downstream side thereof;
  - (b) at least one valve assembly disposed within the interior of the valve housing for controlling the fluid flow therethrough, said valve assembly including:
    - (i) a valve seat positioned in the interior of the valve housing;
    - (ii) a seal retainer positioned in the interior of the valve housing downstream from the valve seat and mounted on a stem, said seal retainer and said stem axially moveable away from the valve seat in response to fluid flow in a downstream direction at a predetermined flow rate, and axially moveable towards and into sealing engagement with the valve seat in response to a downstream fluid flow at a flow rate less than the predetermined flow rate;
    - (iii) a plurality of springs pivotally mounted in the interior of the valve housing interconnecting the valve housing and stem for normally maintaining the seal retainer in sealing engagement with the valve seat in the absence of said predetermined fluid flow rate, said springs positioned in radial opposition to one another and extending outwardly from the stem in the downstream direction to cause the seal retainer to move away from the valve seat in response to fluid flow in the downstream direction, thereby increasing the force of the stem on the springs and causing the springs to pivot and compress to produce a diminishing resultant spring load on the stem; and

- (iv) a return member mounted on the stem for providing a return motion to the plurality of springs, the biasing force of the return member providing an assist to the motion of the stem in the upstream direction upon a predetermined reduction in fluid flow to assist in returning the seal retainer into sealing engagement with the valve seat.

2. A poppet-type check valve for controlling fluid flow, comprising:

- (a) a valve housing having an interior for permitting fluid flow from an upstream side to a downstream side thereof;
- (b) at least one valve assembly disposed within the interior of the valve housing for controlling the fluid flow therethrough, said valve assembly including:
  - (i) a valve seat positioned in the interior of the valve housing;
  - (ii) a stem guide mounted on a downstream side of said valve seat and carrying an axially-mounted stem mounted for sliding movement therein;
  - (iii) a seal retainer positioned in the interior of the valve housing downstream from the valve seat and mounted on the stem, said seal retainer and said stem axially moveable away from the valve seat in response to fluid flow in a downstream direction at a predetermined flow rate, and axially moveable towards and into sealing engagement with the valve seat in response to a downstream fluid flow at a flow rate less than the predetermined flow rate;
  - (iv) a plurality of springs pivotally mounted in the interior of the valve housing interconnecting the valve housing and stem for normally

maintaining the seal retainer in sealing engagement with the valve seat in the absence of said predetermined fluid flow rate, said springs positioned in radial opposition to one another and extending outwardly from the stem in the downstream direction to cause the seal retainer to move away from the valve seat in response to fluid flow in the downstream direction, thereby increasing the force of the stem on the springs and causing the springs to pivot and compress to produce a diminishing resultant spring load on the stem; and

- (v) a return member mounted on the stem for providing a return motion to the plurality of springs, the biasing force of the return member providing an assist to the motion of the stem in the upstream direction upon a predetermined reduction in fluid flow to assist in returning the seal retainer into sealing engagement with the valve seat.

3. A poppet-type check valve according to Claims 1 or 2, wherein each of said springs is positioned for being axially compressed and expanded between two angles responsive to the movement of the seal retainer, each of said angles oblique to the direction of fluid flow through the valve housing.

4. A poppet-type check valve according to Claim 3, wherein said valve assembly includes three springs, each of said springs having first and second ends.

5. A poppet-type check valve according to Claim 4, wherein said springs are positioned in equally-spaced relation to one another.

6. A poppet-type check valve according to Claim 5, wherein said first ends are positioned on the stem in equally-spaced relation to one another, and said second ends are positioned 120 degrees apart from one another and extend downstream from said first ends.

7. A poppet-type check valve according to Claim 1 or 2, wherein said return member comprises a return spring positioned concentrically around the stem downstream from the plurality of springs and upstream from the seal retainer.

8. A poppet-type check valve according to Claim 7, wherein said return spring is positioned and captured within a collar assembly mounted concentrically around the stem downstream from the plurality of springs and upstream from the seal retainer, the collar assembly mounted for sliding movement on the stem between:

- (a) a sealing position wherein the seal retainer is sealed against the valve seat and the return spring is in an expanded condition and the collar assembly is out of biasing contact with the stem; and

- (b) a flow position wherein the seal retainer is spaced-apart from the valve seat to permit fluid flow through the valve, the return spring is in a compressed condition and the collar assembly is in engagement with the springs for exerting a biasing force against the stem in an upstream direction for providing an assist to the springs in closing the valve responsive to a drop in flow pressure through the valve.

9. A poppet-type check valve according to Claim 1 or 2, wherein each of said springs are mounted on first and second ends by respective first and second hinges.

10. A poppet-type check valve according to Claim 9, wherein said first hinge is carried by said stem and said second hinge is carried peripherally by the valve seat.